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Hoverflies (Diptera: Syrphidae) of El Ventorrillo Biological Station, Madrid province, Spain: a perspective from a late twentieth century inventory

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Abstract: Temporal comparisons of a site's biodiversity depend on the availability of at least two asynchronous data sets on a bioindicator group. The Sierra de Guadarrama, a mountain range in central Spain has a high biodiversity and representative sites such as El Ventorrillo Biological Station (Madrid province) play an important role in research and monitoring of the Sierra biodiversity. Although unevenly and randomly, hoverflies of the Sierra de Guadarrama have been surveyed for decades, but never at El Ventorrillo. This important group of pollinators, aphid predators and bioindicators was sampled with a Malaise trap at El Ventorrillo from June 1989 to June 1990. A total of 51 species were identified (20 spp. of Eristalinae and 31 spp. of Syrphinae), 22 of which were new to the Sierra de Guadarrama and 17 to the Madrid province. The genera *Brachypalpus* and *Didea* were also new to the Madrid province. The Sierra de Guadarrama now has 126 species recorded and the Madrid province 150. Within the Sierra de Guadarrama, El Ventorrillo becomes the second locality in number of hoverfly species recorded after El Escorial (64 spp.). In the Malaise trap catch, hoverflies with zoophagous larvae had a higher representation than those of other guilds, both in species richness and abundance. The results provided here for El Ventorrillo represent a baseline for future biodiversity studies at this site with a similar experimental design, for example, to detect changes in hoverfly diversities along time.

Keywords: Eristalinae, Syrphinae, species richness, Sistema Central, Sierra de Guadarrama, Puerto Navacerrada, Malaise trap.

INTRODUCTION

Hoverflies are diverse, both in species and ecology, and occur in most habitats and regions (Marshall, 2012), pollinate many plants and control populations of other insects (Rotheray & Gilbert, 2011). They can be used as indicators of habitat integrity (Speight & Castella, 2005) and Global Change (Rotheray & Gilbert, 2011). Changing climate may have negative effects on hoverflies; for instance, in southern Europe, populations of saproxylic species (larvae dependent on moist microhabitats in trees, such as rot holes) are thought to decrease in the future under a projected warming climate (Marcos García & Ricarte, 2009). Diversity comparisons over time in accordance with available climatic data may help to understand the effects of climate change on biodiversity, but this requires that temporal series of data on diversity surveys are available.

Highlands represent areas of endemicity and high biodiversity levels within the Mediterranean Basin (García-Barros *et al*., 2002; Reyero, 2002; Marcos-García *et al*., 2007). The Sierra de Guadarrama, located in central Spain, is one of the Iberian locations with the most significant biodiversity (Lobo *et al*., 2001; Lobo & Martín-Piera, 2002; Nieves-Aldrey *et al*., 2003). For example, 1310 species of Hymenoptera are known to occur at El Ventorrillo (Madrid), a representative site within Sierra de Guadarrama, and in total 13000 insect species are estimated to occur at this single site (Nieves-Aldrey *et al*., 2003). Its remarkable entomological diversity justifies the status of part of Sierra de Guadarrama as a national park since 2013. This Sierra is included mainly in the provinces of Madrid and Segovia, and most of the national park's surface belongs to the province of Madrid.

With 135 species, the province of Madrid has the third highest number of hoverfly species recorded for a Spanish province (Ricarte & Marcos-García, 2017; Grković *et al*., 2019; Van Steenis *et al*., 2020). Gil-Collado (1930) provided hoverfly records for 14 localities in the Sierra de

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Guadarrama: Cercedilla, Collado Mediano, El Escorial, El Espinar, El Paular, Guadarrama, Los Molinos, Lozoya, Navacerrada, La Granja/San Ildefonso, San Rafael, Sierra de Guadarrama, Valle del Paular and Valsaín (Fig. 1). Later on, Peris (1962) described *Sericomyia hispanica* Peris, 1962 based on specimens from Cercedilla and La Granja reported by Gil-Collado (1930) as *Sericomyia lappona* (Linnaeus, 1758). Marcos-García & Louis (2001) also reported some hoverfly species from Sierra de Guadarrama. Marcos-García *et al.* (2007) treated unpublished material of *Merodon unguicornis* Strobl *in* Czerny & Strobl, 1909 from Cercedilla and designated a lectotype for *Merodon escorialensis* Strobl *in* Czerny & Strobl, 1909 from two syntypes collected at El Escorial. Van Steenis & Lucas (2011) reported *Pipizella lyneborgi* Torp Pedersen, 1971 based on specimens collected at El Escorial 2-3 years after its original description.

Within the Sierra de Guadarrama, some major insect groups are clearly understudied. For example, prior to this study only 27 species of five Dipteran families were known from El Ventorrillo (Kehlmaier, 2004, 2005; Kehlmaier *et al*., 2019), with no records of bioindicator families such as hoverflies. Between 1988 and 1991, insects were systematically surveyed at El Ventorrillo, with more than a million specimens caught. Diptera was the most abundant group in these samples, with nearly half of the total number of collected specimens (Nieves-Aldrey *et al*., 1991, 2003).

The main aim of the present study is to increase our knowledge on hoverfly distribution and phenology in the Sierra de Guadarrama by presenting a list of the hoverflies collected at El Ventorrillo with a Malaise trap over a one year period. The long term goal is to facilitate future comparisons of temporal diversities. The results

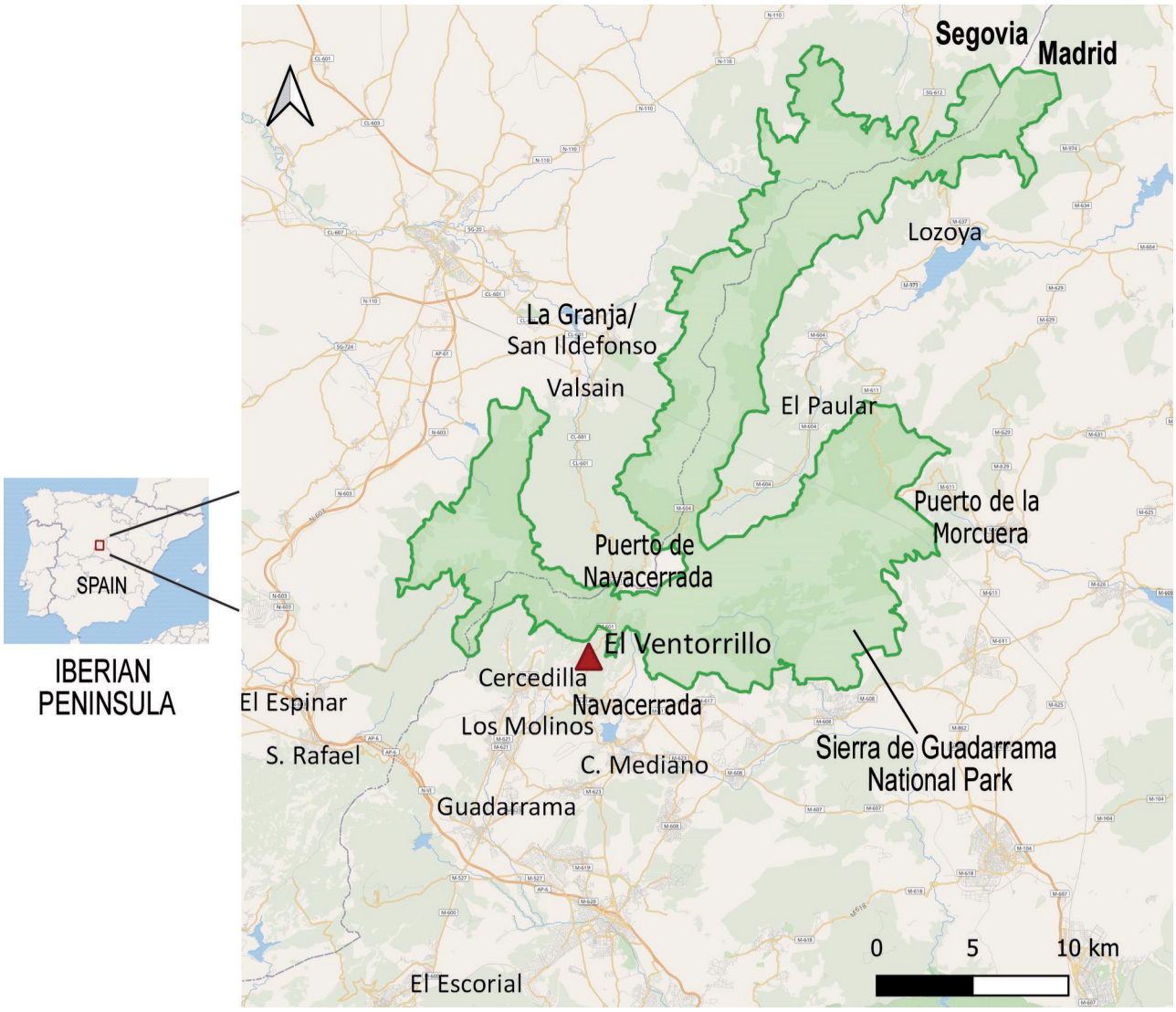


Fig. 1: Sierra de Guadarrama (Spain). El Ventorrillo is indicated with a red triangle. All labelled localities belong to Sierra de Guadarrama, although found outside the borders of the national park.

are also placed in the wider framework of the hoverfly diversity of the Sierra de Guadarrama and that of the province of Madrid.

MATERIAL AND METHODS

Study area

The Sierra de Guadarrama, with altitudes above 2000 m, belongs to the Sistema Central mountain range of Spain. El Ventorrillo (40°45'16.5"N 4°01'15.5"W, 1482 m) is a Biological Station of the 'Museo Nacional de Ciencias Naturales' (MNCN) (CSIC-Consejo Superior de Investigaciones Científicas), located on the south slope of Sierra de Guadarrama, in Cercedilla (Madrid province), about 60 km from the metropolis of Madrid (Nieves-Aldrey *et al*., 2003) (Fig. 1). The climate is subhumid Mediterranean tending to central European (Allué Andrade, 1987), with cold winters, possible freezes from September to June, 1000-1600 mm/year of precipitation, and a short, dry, and warm period in July-August ('Puerto de Navacerrada' as weather reference).

The area's vegetation is supra Mediterranean (Rivas Martínez, 1982), but the original vegetation has been largely replaced by plantations of *Pinus sylvestris* L. The vegetation at El Ventorrillo consists of a dense human-modified forest mainly of maples (*Acer pseudoplatanus* L.) and mountain elms (*Ulmus* sp.), but also linden, pine, cedar, fir, poplar, ash and holly. In the lower part of the Station, woodland is replaced by grasslands with roses and brambles. The vegetation at the forest/grassland edge consists of various shrubs such as *Cytisus*, *Crataegus*, *Rubus*, *Rosa*, *Cistus*, *Santolina*, *Juniperus*, and *Prunus*, while in close-by areas outside the Station some patches of *Quercus pyrenaica* Willd. with *Cistus* shrubs occur (Nieves-Aldrey *et al*., 2003) (Fig. 2).

Hoverfly sampling and identification

Insects were collected with a black Malaise trap of American design (Townes, 1972; Darling & Packer, 1988) (Fig. 2), from June 1989 to June 1990, except for the winter months of December to February, by José Luis Nieves-Aldrey & Carmen Rey-del-Castillo. The Malaise trap was placed in a humid site within a grassland/mix-forest edge (Nieves-Aldrey *et al*., 2003) (Fig. 2). Samples were collected in 75% alcohol and the trap was serviced weekly during a period of 240 days. Dipterans were

Fig. 2. El Ventorrillo in summer (Sierra de Guadarrama, Spain). Malaise trap placed in grassland/mix-forest edge.

extracted from the samples by José Luis Nieves-Aldrey and Carmen Rey-del-Castillo. Hoverflies were separated from the other Dipterans by Arabia Sánchez-Terrón in the 90's, and sent in plastic tubes with alcohol to the CIBIO Institute, University of Alicante, for identification. Specimens were dry mounted by Daniel Lorenzo, except for those of very abundant species that were stored in 70% alcohol. Some identified specimens were discarded due to their bad condition, but included in the results (see indications in the material examined).

Specimens were identified by Daniel Lorenzo with the assistance and supervision of Antonio Ricarte (Eristalinae), Zorica Nedeljković (Syrphinae), and M.A. Marcos-García. Keys and descriptions in the following publications were used for genus and species identifications: Violovitsh (1974), Goeldlin de Tiefenau (1976), Van Veen (2004), Vujić & Šimić (1999), Marcos-García *et al*. (2007), Nedeljković *et al*. (2013, 2015), Popović *et al*. (2015), Speight & Sarthou (2017), Van Steenis *et al.* (2017), and Van Steenis *et al.* (2020). The examined material is deposited in the 'Colección Entomológica de la Universidad de Alicante' (CEUA), CIBIO, University of Alicante, Spain.

The species recorded from El Ventorrillo are arranged alphabetically by genus and species (see 'Hoverfly records from El Ventorrillo'). The subfamily is indicated for each genus. Under each species, data on 'material examined' and 'guild' are presented. Ricarte & Marcos-García (2017), Van Steenis *et al.* (2017) and Grković *et al*. (2019) were used to find out which species were new to the Madrid province.

Guild, phenology, biogeography and conservation assessments

Ecological guilds, phenology, biogeographic features and conservation status of the hoverfly species found at El Ventorrillo were assessed. For the functional diversity assessment, species were classified in guilds according to larval trophic habits (Speight, 2020): zoophagous, phytophagous, saprophagous, and saproxylic (see 'Hoverfly records from El Ventorrillo' in results). Both saprophagous and saproxylic larvae feed on decaying organic materials. Saproxylic larvae develop in rot-holes, sap runs, tunnels in fallen wood, or under bark, i.e. they depend on trees while saprophagous larvae are found in decaying herbaceous vegetation of aquatic habitats, mud, dung, manure, and other similar breeding sites (Rotheray, 1994). Thus, sapoxylic species are placed here in a separate guild due to their specific association with usually mature or dead trees and their ecological and conservation implications in woodlands (Speight, 1989). When the larva is unknown, the guild is inferred from other congeneric species with known larvae.

The adult phenology of the collected species of Syrphidae at El Ventorrillo is represented on Table 1 in comparison with their phenology in Europe, taken from Speight (2020). For *Chrysotoxum volaticum* Séguy, 1961 the phenology in Europe follows Van Steenis *et al.* (2020). For the biogeographic assessment, the classification in European biogeographical zones of Speight *et al*. (2016) was used. An assessment of the conservation status of the hoverfly community at El Ventorrillo was also performed based on the threaten categories in Speight *et al*. (2016) for the European continent. In Speight *et al*. (2016) species are coded for a given threat category as 1, 2 or 3. If a species was coded in two categories, the category with highest code was chosen in our analysis. If Speight *et al.* (2016) used the same code twice for a given species (eg., '2, decreasing' + '2, unthreatened' for species A), the category implying a higher level of threat was selected (eg., species A 'decreasing'). *Chrysotoxum* sp. near *C. vernale* and *Chrysotoxum volaticum* were excluded from the biogeographic and conservation assessments due to lack of information.

Checklist of the Sierra de Guadarrama Syrphidae species

The hoverfly checklist for the Sierra de Guadarrama was elaborated in a table (Appendix), by revising all literature with records from localities in the Sierra de Guadarrama, i.e. Gil-Collado (1930), Peris (1962), Marcos-García & Louis (2001), Marcos-García *et al*. (2007), and Van Steenis & Lucas (2011). For references prior to 1930, see Gil-Collado (1930). All localities mentioned in the checklist belong to Sierra de Guadarrama, Madrid province, except for El Espinar, La Granja/San Ildefonso (any of these two names refer to the same locality), San Rafael, and Valsaín, which belong to the Sierra de Guadarrama, Segovia province (Fig. 1). In the table, 'Sierra de Guadarrama (gen.)' is used when the published locality for a bibliographic record is just 'Sierra de Guadarrama', except for *Volucella zonaria* (Poda, 1761) that is assumed to occur in Sierra de Guadarrama just due to its supposed widespread distribution (Gil-Collado, 1930; Ricarte & Marcos-García, 2017). In the checklist, all other species recorded from Madrid province are also listed (Ricarte & Marcos-García, 2017; Grković *et al*., 2019; Van Steenis *et al.*, 2020), in such a way that a checklist of the Syrphidae from the Madrid province can be produced by excluding the species present on the Segovian side of Sierra de Guadarrama, but absent from the Madrid province.

RESULTS

Hoverfly records from El Ventorrillo

All examined specimens or lots of specimens share the following data: 'CEUA; Spain, Madrid, Sierra

de Guadarrama, El Ventorrillo Biological Station, 40º45'11.36"N 4º1'17.19"W; Leg.: J. L. Nieves-Aldrey & C. Rey-del-Castillo'.

Brachypalpus Macquart, 1834 (Eristalinae) (New to Madrid)
***Brachypalpus laphriformis* (Fallén, 1816)** (New to Madrid)
Material examined: 1 male; 7-14.7.1989.
Guild: Saproxylic.

Callicera Panzer, 1806 (Eristalinae)
***Callicera macquarti* Rondani, 1844** (New to Madrid)
Material examined: 1 female; 1-7.5.1990.
Guild: Saproxylic (larva undescribed).

***Callicera rufa* Schummel, 1842**
Material examined: 1 female; 1-7.9.1989.
Guild: Saproxylic.

Cheilosia Meigen, 1822 (Eristalinae)
***Cheilosia gigantea* (Zetterstedt, 1838)** (New to Madrid)
Material examined: 1 female; 1-7.5.1990. – 1 female; 15-22.5.1990. – 1 female; 1-6.6.1990.
Guild: Phytophagous.

***Cheilosia laticornis* Rondani, 1857**
Material examined: 1 male; 11-20.4.1990. – 1 female; 1-6.vi.1990.
Guild: Phytophagous (larva undescribed).

***Cheilosia proxima* (Zetterstedt, 1843)** (New to Madrid)
Material examined: 1 female; 1-6.6.1990.
Guild: Phytophagous.

Chrysotoxum Meigen, 1803 (Syrphinae)
***Chrysotoxum volaticum* Séguy, 1961**
Material examined: 3 males; 22-30.6.1989. – 3 males; 31.6–6.7.1989. – 3 males; 7-14.7.1989. – 3 males; 14-21.7.1989. – 1 female; 11-18.8.1989.
Guild: Zoophagous (larva undescribed).

***Chrysotoxum cisalpinum* Rondani, 1845**
Material examined: 1 male; 7-14.7.1989. – 2 males; 11-18.8.1989.
Guild: Zoophagous (larva undescribed).

***Chrysotoxum festivum* (Linnaeus, 1758)**
Material examined: 1 male; 7-14.7.1989. – 1 male; 14-21.7.1989.
Guild: Zoophagous (larva undescribed).

***Chrysotoxum intermedium* Meigen, 1822**
Material examined: 1 male; 9-16.6.1989. – 2 males; 7-14.7.1989. – 2 females; 15-22.5.1990. – 1 male; 1-6.6.1990.
Guild: Zoophagous (larva undescribed).

***Chrysotoxum latifasciatum* Becker, 1921**
Material examined: 1 male; 9-16.6.1989. – 1 male; 31.6-6.7.1989. – 2 males; 7-14.7.1989. – 1 male; 14-21.7.1989. – 1 female; 28.7-4.8.1989. – 1 female; 1-6.6.1990.
Guild: Zoophagous (larva undescribed).

***Chrysotoxum octomaculatum* Curtis, 1837**
Material examined: 1 male; 22-30.6.1989. – 2 males; 31.6–6.7.1989. – 6 males; 7-14.7.1989. – 6 males; 14-21.7.1989. – 2 females; 28.7-4.8.1989. – 1 male; 15-22.5.1990.
Guild: Zoophagous (larva undescribed).

***Chrysotoxum* sp. near *vernale* Loew, 1841** (New to Madrid)
Fig. 6C
Material examined: 1 male, 9-16.6.1989. – 1 female; 22-30.6.1989. – 1 female; 14-21.7.1989. – 1 female; 22-30.3.1990. – 1 female; 11-20.4.1990. – 1 male and 2 females; 15-22.5.1990. – 2 females; 23-31.5.1990. – 1 male and 3 females; 1-6.6.1990.
Guild: Zoophagous (larva undescribed).
Remarks: This species is currently being described by Nedeljković *et al.* (in press).

Dasysyrphus Enderlein, 1938 (Syrphinae)
***Dasysyrphus albostriatus* (Fallén, 1817)**
Fig. 6D
Material examined: 5 females; 9-16.6.1989. – 1 male; 22-30.6.1989. – 2 males and 1 female; 14-21.7.1989; 2 males and 2 females (all discarded); 25-31.8.1989. – 4 males and 2 females; 1-7.9.1989. – 1 female (discarded); 14-21.11.1989. – 1 male and 1 female; 21-28.9.1989. – 1 male; 23-31.5.1990.
Guild: Zoophagous.

***Dasysyrphus pauxillus* (Williston, 1887)** (New to Madrid)
Material examined: 1 male; 9-16.6.1989. – 4 males and 1 female; 23-31.5.1990. – 2 males; 1-6.6.1990.
Guild: Zoophagous (larva undescribed).

***Dasysyrphus tricinctus* (Fallén, 1817)** (New to Madrid)
Material examined: 1 male; 1-6.6.1990.
Guild: Zoophagous.

Didea Macquart, 1834 (Syrphinae) (New to Madrid)
***Didea intermedia* Loew, 1854** (New to Madrid)
Material examined: 1 female (discarded); 25-31.8.1989. – 1 female; 1-7.9.1989.
Guild: Zoophagous.

Episyrphus Matsumura & Adachi, 1917 (Syrphinae)
***Episyrphus balteatus* (De Geer, 1776)**
Material examined: 1 male and 1 female; 7-14.7.1989. – 19 males and 9 females, 14-21.7.1989. – 1 male and 5 females; 20-28.7.1989. – 5 females (1 female discarded);

28.7-4.8.1989. – 2 females; 11-18.8.1989. – 1 female (discarded); 25-31.8.1989. – 1 male; 11-20.4.1990. – 2 males and 2 females; 15-22.5.1990. – 8 males and 1 female; 23-31.5.1990. – 1 male; 1-6.6.1990.
Guild: Zoophagous.

Eristalis Latreille, 1804 (Eristalinae)
***Eristalis arbustorum* (Linnaeus, 1758)**
Material examined: 1 male; 31.6-6.7.1989. – 1 male and 1 female; 7-14.7.1989. – 1 female; 14-21.7.1989. – 1 female; 28.7-4.8.1989.
Guild: Saprophagous.

***Eristalis horticola* (De Geer, 1776)**
Material examined: 1 female; 7-14.7.1989. – 2 males; 14-21.7.1989.
Guild: Saprophagous.

***Eristalis similis* (Fallén, 1817)**
Material examined: 2 males and 1 female; 14-21.7.1989.
Guild: Saprophagous.

***Eristalis tenax* (Linnaeus, 1758)**
Material examined: 1 male; 7-14.7.1989. – 1 male; 14-21.7.1989. – 1 male (discarded); 14-21.11.1989.
Guild: Saprophagous.

Eumerus Meigen, 1822 (Eristalinae)
Eumerus consimilis Šimić & Vujić, 1996 (New to Madrid)
Material examined: 1 male and 1 female; 1-7.9.1989.
Guild: Phytophagous (larva undescribed).

***Eumerus sabulonum* (Fallén, 1817)**
Material examined: 1 male and 1 female; 9-16.6.1989.
Guild: Phytophagous (larva undescribed).

***Eumerus sulcitibius* Rondani, 1868** (New to Madrid)
Material examined: 1 female; 1-6.6.1990.
Guild: Phytophagous (larva undescribed).

Eupeodes Osten Sacken, 1877 (Syrphinae)
***Eupeodes corollae* (Fabricius, 1794)**
Material examined: 2 males and 16 females; 9-16.6.1989. – 7 females; 22-30.6.1989. – 2 males and 3 females (2 males and 2 females discarded); 31.6-6.7.1989. – 65 males and 87 females; 14-21.7.1989. – 5 males and 26 females; 20-28.7.1989. – 1 male and 54 females; 7-14.8.1989. – 12 males and 22 females (4 males and 10 females discarded); 28.7-4.8.1989. – 1 male and 16 females; 11-18.8.1989. – 3 females (discarded); 25-31.8.1989. – 1 female; 1-7.9.1989. – 1 female (discarded); 11-25.10.1989. – 1 female; 21-28.9.1989. – 1 female (discarded); 2-9.11.1989. – 2 females (discarded); 14-21.11.1989. – 1 male and 1 female; 11-20.4.1990. – 1 male and 10 females; 15-22.5.1990. – 1 male and 7 females; 23-31.5.1990. – 1 male and 1 female; 1-6.6.1990.
Guild: Zoophagous.

***Eupeodes latifasciatus* (Macquart, 1829)** (New to Madrid)
Material examined: 3 females; 9-16.6.1989. – 2 males and 1 female; 7-14.7.1989. – 3 females; 21-28.9.1989.
Guild: Zoophagous.

***Eupeodes luniger* (Meigen, 1822)**
Material examined: 2 females; 9-16.6.1989. – 1 female; 7-14.7.1989. – 2 females; 14-21.7.1989. – 1 male; 20-28.7.1989. – 1 male; 7-15.5.1990.
Guild: Zoophagous.

Melanostoma Schiner, 1860 (Syrphinae)
***Melanostoma mellinum* (Linnaeus, 1758)**
Material examined: 2 males and 10 females; 9-16.6.1989. – 4 females; 22-30.6.1989. – 1 female (discarded); 31.6-6.7.1989. – 17 males and 6 females; 14-21.7.1989. – 13 males and 4 females; 20-28.7.1989. – 4 males and 5 females; 28.7-4.8.1989. – 7-14.8.1989. – 1 male; 11-18.8.1989. – 4 males and 5 females; 15-22.5.1990. – 30 males and 9 females; 23-31.5.1990. – 6 males and 7 females; 1-6.6.1990.
Guild: Zoophagous.

***Melanostoma scalare* (Fabricius, 1794)**
Material examined: 1 female; 9-16.6.1989. – 4 females; 22-30.6.1989. – 5 males and 10 females; 14-21.7.1989. – 1 male and 4 females; 20-28.7.1989. – 1 male and 2 females; 28.7-4.8.1989. – 2 males and 12 females; 7-14.8.1989. – 1 male and 1 female; 11-18.8.1989. – 1 female; 1-7.9.1989. – 1 male and 1 female; 15-22.5.1990. – 7 males and 10 females; 23-31.5.1990. – 1 female; 1-6.6.1990.
Guild: Zoophagous.

Meliscaeva Frey, 1946 (Syrphinae)
***Meliscaeva auricollis* (Meigen, 1822)**
Material examined: 1 male; 22-30.6.1989. – 12 males; 7-14.7.1989. – 65 males and 13 females; 14-21.7.1989. – 1 male; 20-28.7.1989. – 3 males; 28.7–4.8.1989. – 1 female; 1-7.9.1989. – 1 male and 1 female; 21-28.9.1989. – 1 male; 23-31.5.1990. – 1 male; 1-6.6.1990.
Guild: Zoophagous.

Merodon Meigen, 1803 (Eristalinae)
***Merodon ibericus* Vujić *in* Popović *et al.*, 2015** (New to Madrid)
Material examined: 1 male and 2 females; 7-14.7.1989. – 3 males; 14-21.7.1989.
Guild: Phytophagous (larva undescribed).

***Merodon unguicornis* Strobl, 1909 *in* Czerny & Strobl, 1909**
Material examined: 1 female; 22-30.6.1989. – 2 females; 15-22.5.1990. – 1 female; 23-31.5.1990. – 3 females; 1-6.6.1990.
Guild: Phytophagous (larva undescribed).

***Merodon unicolor* Strobl *in* Czerny & Strobl, 1909**
Material examined: 4 males; 23-31.5.1990.
Guild: Phytophagous (larva undescribed).

Neoascia Williston, 1887 (Eristalinae)
***Neoascia podagrica* (Fabricius, 1775)**
Material examined: 2 females; 15-22.5.1990.
Guild: Saprophagous.

Paragus Latreille, 1804 (Syrphinae)
***Paragus bicolor* (Fabricius, 1794)**
Material examined: 1 female; 28.7-4.8.1989. – 1 female; 1-6.6.1990.
Guild: Zoophagous (larva undescribed).

***Paragus pecchiolii* Rondani, 1857** (New to Madrid)
Material examined: 1 male; 14-21.7.1989.
Guild: Zoophagous.

***Paragus strigatus* Meigen, 1822**
Material examined: 1 female; 9-16.6.1989.
Guild: Zoophagous (larva undescribed).

Parasyrphus Matsumura *in* Matsumura & Adachi, 1917 (Syrphinae)
***Parasyrphus punctulatus* (Verrall, 1873)** (New to Madrid)
Material examined: 1 male; 7-15.5.1990.
Guild: Zoophagous.

Pelecocera Meigen, 1822 (Eristalinae)
***Pelecocera caledonica* (Collin, 1940)** (New to Madrid)
Material examined: 1 female; 21-28.9.1989. – 1 male; 1-6.6.1990.
Guild: Phytophagous (larva undescribed).

Platycheirus Lepeletier & Serville, 1828 (Syrphinae)
***Platycheirus albimanus* (Fabricius, 1781)**
Material examined: 1 female; 14-21.7.1989. – 1 female; 20-28.7.1989.
Guild: Zoophagous.

***Platycheirus scutatus* (Meigen, 1822)** (New to Madrid)
Material examined: 1 female; 31.6-6.7.1989. – 1 female; 28.7-4.8.1989. – 2 males; 15-22.5.1990. – 1 male; 1-6.6.1990.
Guild: Zoophagous.

Scaeva Fabricius, 1805 (Syrphinae)
***Scaeva pyrastri* (Linnaeus, 1758)**
Material examined: 1 female; 22-30.6.1989. – 1 female (discarded); 31.6-6.7.1989. – 1 male (discarded); 14-21.7.1989. – 1 female; 21-28.9.1989. – 1 female; 14-21.11.1989.
Guild: Zoophagous.

Sphaerophoria Lepeletier & Serville, 1828 (Syrphinae)
***Sphaerophoria scripta* (Linnaeus, 1758)**
Material examined: 6 males and 9 females; 9-16.6.1989. – 11 males and 25 females; 22-30.6.1989. – 21 males and 39 females (discarded); 31.6-6.7.1989. – 50 males; 7-14.7.1989. – 156 males and 203 females; 14-21.7.1989. – 112 males and 165 females; 20-28.7.1989. – 70 males and 130 females (39 males and 66 females discarded); 28.7–4.8.1989. – 51 males; 7-14.8.1989. – 1 male and 3 females; 11-18.8.1989. – 1 female; 14-22.3.1990. – 2 females; 7-15.5.1990. – 3 males and 23 females; 15-22.5.1990. – 18 males and 35 females; 23-31.5.1990. – 9 males and 6 females; 1-6.6.1990.
Guild: Zoophagous.

Syritta Lepeletier & Serville, 1828 (Eristalinae)
***Syritta pipiens* (Linnaeus, 1758)**
Material examined: 1 female; 28.7-4.8.1989.
Guild: Saprophagous.

Syrphus Fabricius, 1775 (Syrphinae)
***Syrphus ribesii* (Linnaeus, 1758)**
Material examined: 1 female; 9-16.6.1989. – 2 females; 22-30.6.1989. – 1 female; 31.6-6.7.1989. – 1 male and 1 female; 7-14.7.1989. – 1 male and 1 female; 14-21.7.1989. – 1 male; 20-28.7.1989.
Guild: Zoophagous.

***Syrphus torvus* Osten Sacken, 1875**
Material examined: 2 females; 9-16.6.1989. – 1 male and 2 females; 14-21.7.1989. – 1 male; 20-28.7.1989.
Guild: Zoophagous.

***Syrphus vitripennis* Meigen, 1822**
Material examined: 1 female; 21-28.9.1989. – 1 male; 15-22.5.1990.
Guild: Zoophagous.

Volucella Geoffroy, 1762 (Eristalinae)
***Volucella elegans* Loew, 1862**
Material examined: 1 male; 7-14.7.1989.
Guild: Zoophagous (larva undescribed).

Xanthandrus Verrall, 1901 (Syrphinae)
***Xanthandrus comtus* (Harris, 1780)**
Material examined: 1 male; 14-21.7.1989.
Guild: Zoophagous.

Xanthogramma Schiner, 1860 (Syrphinae)
***Xanthogramma dives* (Rondani, 1857)** (New to Madrid)
Material examined: 1 female; 11-18.8.1989. – 1 female; 21-28.9.1989.
Guild: Zoophagous (larva undescribed).

Guilds, phenology, biogeography and conservation

In the Malaise trap samples, hoverflies of 51 species were collected, with 31 species of Syrphinae and 20 of Eristalinae (Table 1 and Appendix). Neither Microdontinae nor Pipizinae were collected. Zoophagous dominated both in species richness and abundance. In fact, a minimal proportion of individuals (below 3%) belonged to guilds other than zoophagous (Fig. 3).

Many species such as *Cheilosia laticornis* were recorded just from a short length of time within their flight period in Europe (Table 1). *Callicera macquarti* flies in June and September/October, but the female reported here was caught in early May. In a similar way, *Callicera rufa* is known to fly from mid May to August and the female recorded at El Ventorrilo was collected in early September. *Didea intermedia* was collected in September, one month after its flight period ends in Europe. For *Merodon unicolor* and *Chrysotoxum volaticum*, sub-populations from North Africa were also considered in the 'European' phenology. The phenology of *Chrysotoxum intermedium* is not provided since the taxonomy of this species is unresolved and several close taxa may exist under this name.

Most species collected at El Ventorrillo are typical for the Mediterranean zone of Europe (45 out of 51 spp.) closely followed by species occurring mainly in the Atlantic and Continental zones (40 spp. each). The lowest number of species are characterized having Macaronesian (16 spp.) and Arctic (12 spp.) distributions (Fig. 4). The majority of species recorded are unthreatened, four are decreasing

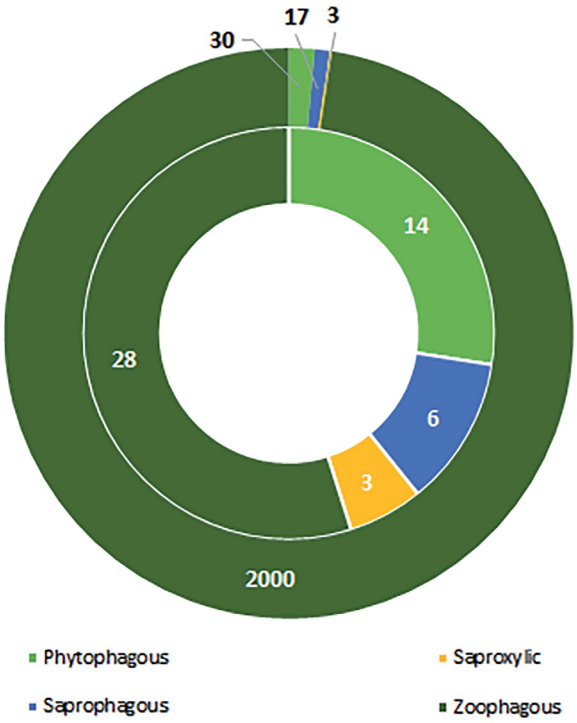


Fig. 3. Guild diversity of El Ventorrillo hoverflies. Inner circle, for species richness; outer circle, for abundance. 'Saproxylic' is used for saprophagous species depending on trees.

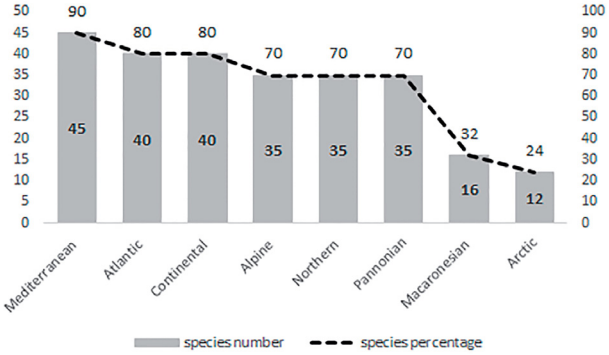
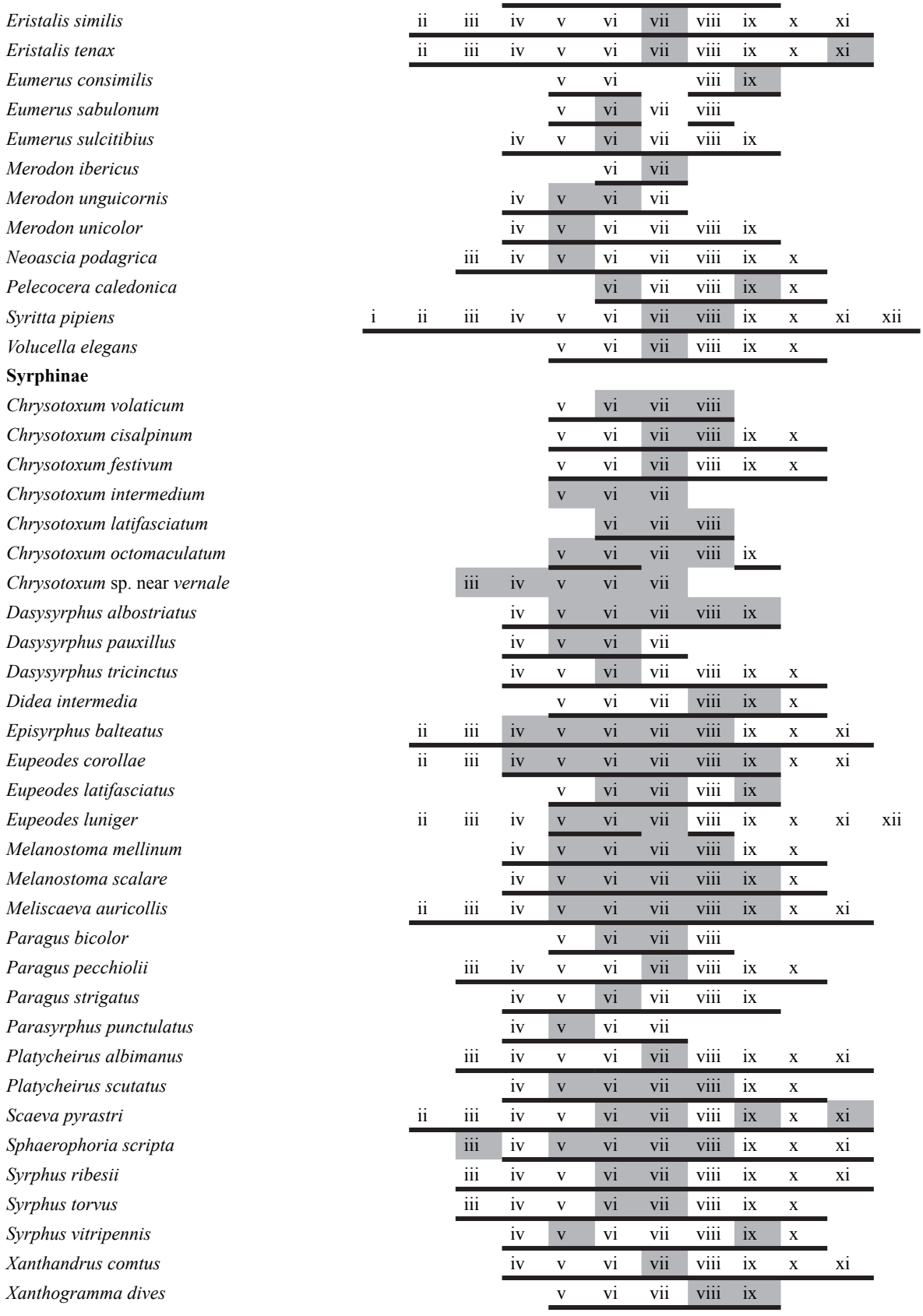


Fig. 4. Biogeographic diversity of El Ventorrillo hoverflies. Species known to be present in each biogegraphic zone of Europe, expressed both in species richness (within grey bar) and percentage (above bar) calculated from the total number of species found at El Ventorrillo. Notice that a species can be present in more than one biogeographic zone.

Table 1. Phenology of El Ventorrillo hoverflies. The flight period of adults in Europe is indicated with a black line while El Ventorrillo flight period is indicated in grey. Months: i, January; ii, February; iii, March; iv, April; v, May; vi, June; vii, July; viii, August; ix, September; x, October; xi, November; xii, December.

	i	ii	iii	iv	v	vi	vii	viii	ix	x	xi	xii
Eristalinae												
Brachypalpus laphriformis					v	vi	vii					
Callicera macquarti					v	vi			ix	x		
Callicera rufa					v	vi	vii	viii	ix			
Cheilosia gigantea					v	vi	vii	viii				
Cheilosia laticornis				iv	v	vi	vii	viii	ix			
Cheilosia proxima				iv	v	vi	vii	viii	ix			
Eristalis arbustorum				iv	v	vi	vii	viii	ix	x		
Eristalis horticola				iv	v	vi	vii	viii	ix			



in number of populations or range at the European level (*Callicera rufa*, *Chrysotoxum cisalpinum*, *C. octomaculatum* and *Eumerus consimilis*), and two are probably threatened with extinction (*Callicera macquarti* and *Pelecocera caledonica*). The latter two species were represented by singletons or doubletons in the sample. *Chrysotoxum intermedium*, *C. latifasciatum*, *Merodon ibericus*, and *M. unguicornis* are regarded as data deficient in Europe.

Hoverfly fauna of Sierra de Guadarrama

With this study, 21 species are added to the checklist of the hoverflies of the Sierra de Guadarrama that is updated now to a total of 126 species (see Appendix). The genera *Brachypalpus*, *Didea*, *Dasysyrphus*, *Neoascia*, *Parasyrphus*, *Syritta*, and *Xanthandrus* are reported for the first time from Sierra de Guadarrama. Peris (1962) excluded *S. lappona* from the Spanish fauna of *Sericomyia*, but apparently he did not examine the material of *S. lappona* from El Escorial reported by Gil-Collado (1930). Thus, we retain *S. lappona* in the Sierra de Guadarrama checklist until this genus is revised in the Iberian Peninsula. The record of *Chrysotoxum bicinctum* (Linnaeus, 1758) from Cercedilla is likely to be a misidentification of *C. volaticum* but we retain *C. bicintum* in the Sierra de Guadarrama – and Madrid – checklist until the material from Cercedilla is revised. Although *Syritta pipiens* is one of the most common hoverflies in Spain (Gil-Collado, 1930; Ricarte & Marcos-García, 2017) and it is most likely to occur everywhere in Sierra de Guadarrama, the specimen reported here represents the first documented record from Sierra de Guadarrama. In the Malaise trap inventory discussed here, 40% of the species found in the Sierra de Guadarrama are represented.

Within the Sierra de Guadarrama, El Escorial is the locality with the highest number of species recorded (64 spp.), followed by El Ventorrillo (51 spp.), both in Madrid province. Valle del Paular and Navacerrada, also in Madrid, are clearly under-recorded (one species each). La Granja/San Ildefonso is the Segovian locality in Sierra de Guadarrama with the highest number of species recorded, although the absolute number is still low (19 spp.) (Fig. 5). In 11 out of 14 localities of Sierra de Guadarrama, 50% or more of the collected species are eristalines, but the only locality sampled with a systematic technique, El Ventorrillo, has a higher proportion of syrphine species than eristaline species (61% vs. 39%). The hoverfly diversities in all the mentioned localities (Fig. 5) are not comparable with each other due to different sampling efforts and techniques used by the different collectors over time. However, Fig. 5 is still

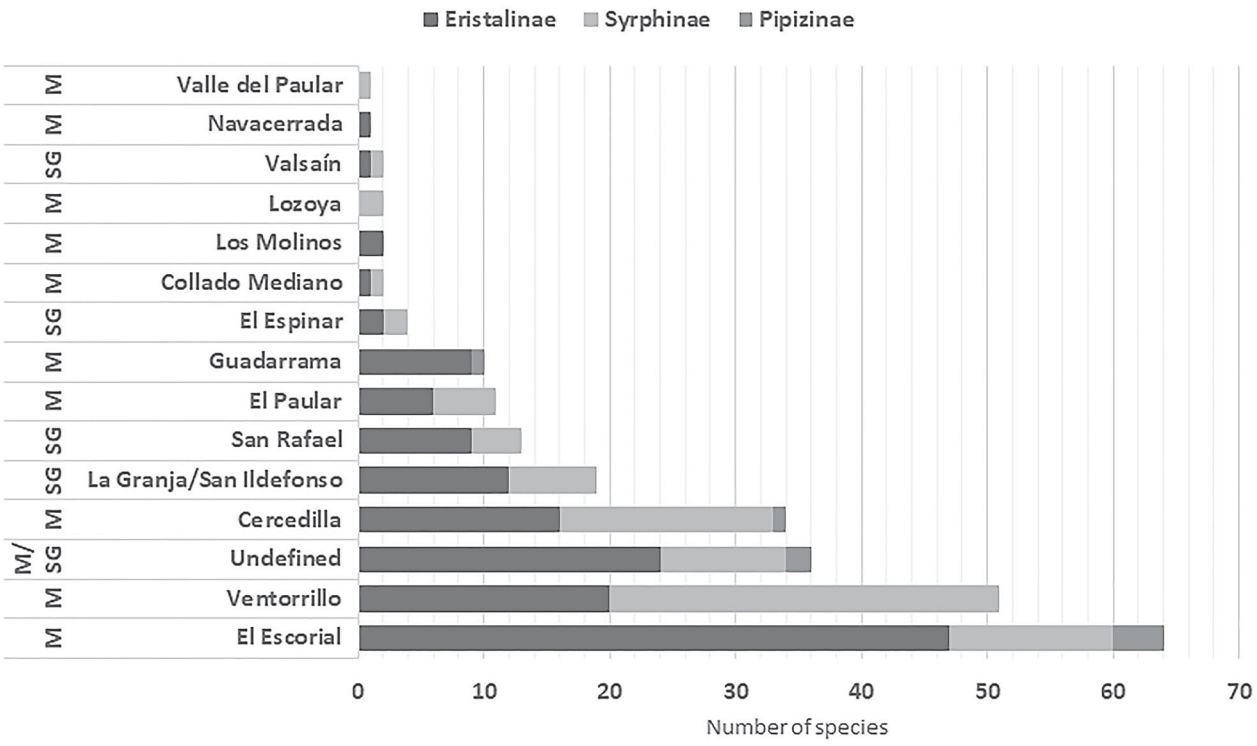


Fig. 5. Hoverfly diversity of Sierra de Guadarrama (species richness). All localities with hoverfly records in the literature are included. The category 'undefined' refers to unspecified localities within Sierra de Guadarrama. M, Madrid province; SG, Segovia province.

useful in understanding how uneven hoverfly knowledge is in Sierra de Guadarrama and to show basic tendencies based on Malaise trap sampling.

In this study, 17 species and two genera are new to Madrid province and the checklist of the Syrphidae from this province consists now of 150 species (Appendix). Madrid is still the third Spanish province in hoverfly species richness, after León (182 spp.) (Ricarte & Marcos-García, 2017) and Salamanca (152 spp.) (Ricarte *et al.*, 2018). In the Malaise trap catch of El Ventorrillo, 34% of species found in the Madrid province are represented. Following the present study, microdontines are still uknown to the province of Madrid.

DISCUSSION

In this study, 17 hoverfly species and two genera were found to be new to Madrid province from a Malaise trap catch originating from El Ventorrillo, Sierra de Guadarrama, dating from 1989-1990. One of the most remarkable aspects brought to light by these results is the

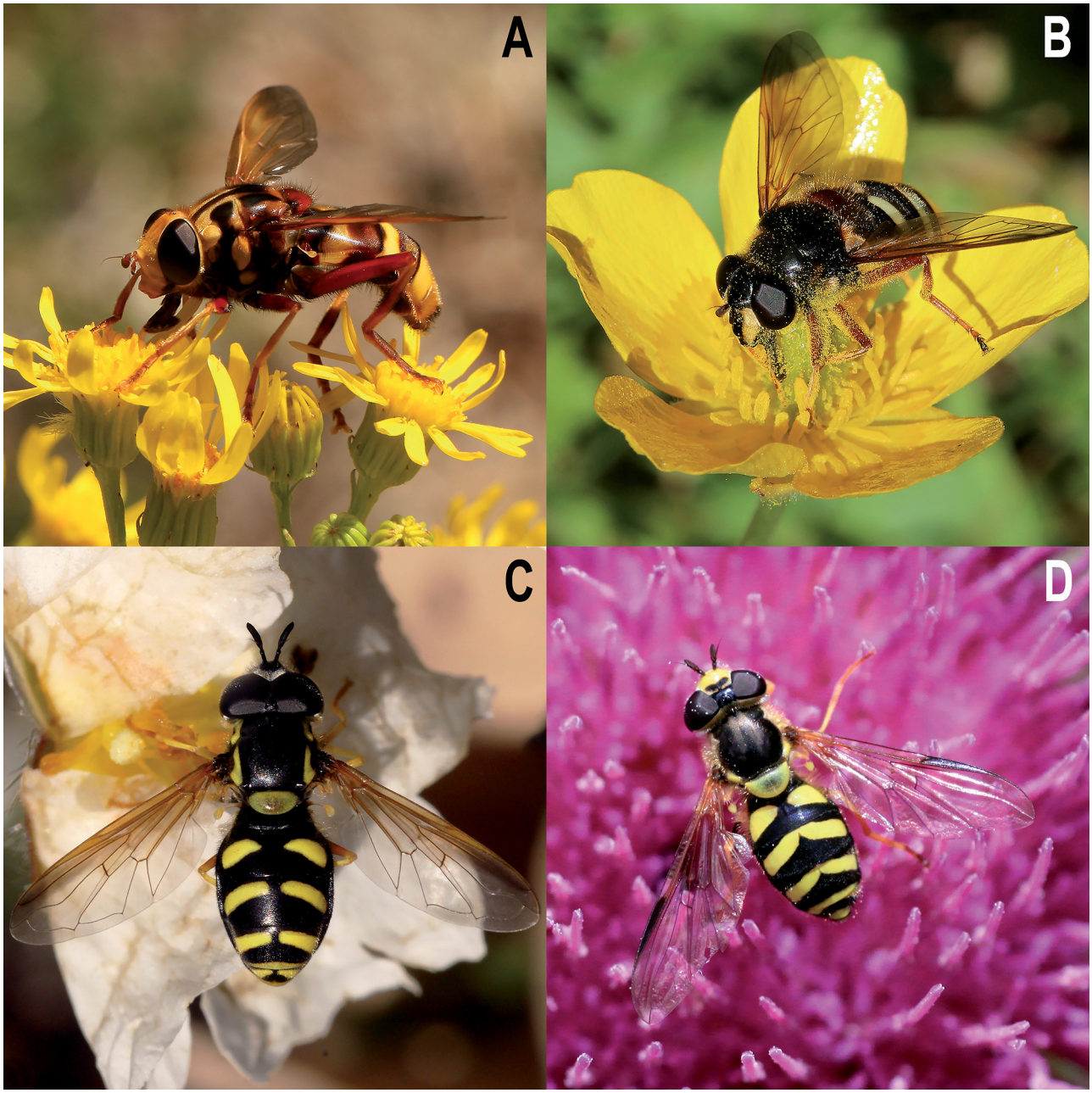


Fig. 6. Hoverfly species from Sierra de Guadarrama. (A) *Milesia crabroniformis*, female, Puerto de Navacerrada. (B) *Sericomyia hispanica*, female, Puerto de Navacerrada. (C) *Chrysotoxum* sp. near *vernale*, male, Puerto de la Morcuera. (D) *Dasysyrphus albostriatus*, female. Photos A, B, D by Piluca Álvarez-Fidalgo, C by Marián Álvarez-Fidalgo.

lack of long term surveys of the hoverfly fauna of Madrid since 1989. Only a few species have been reported from Madrid in scattered publications in the last 30 years (see some examples in Appendix). On the one hand, these results show how important long term surveys are even in a province whose hoverfly diversity is thought to be well known (Ricarte & Marcos-García, 2017). On the other hand, the finding of 21 species new to Sierra de Guadarrama suggests the high potential of this location within the Iberian Peninsula for hoverfly diversity studies, as shown by other insect groups (Lobo & Martín-Piera, 2002; Nieves-Aldrey *et al*., 2003).

The hoverfly community of El Ventorrillo was represented in the Malaise trap catch by 51 species, most of them Mediterranean faunistic elements (Fig. 4), without records of Microdontinae and Pipizinae. Syrphinae were dominant in the samples, with more than half of the species (31 spp.) and individuals of Syrphidae identified (1999 out of 2050). These results were consistent with previous findings. For example, syrphines appear to be less specialised in flower visitation than other subfamilies (Klecka *et al*., 2018) and this fact is likely to facilitate a higher species diversity of syrphines with no regard of the plant community found in a study site. Syrphines are also known to be more diverse in forests than in other habitats (Branquart & Hemptinne, 2000). The Malaise trap used in the present study was placed in a grassland/forest edge, so an influence from the forest community of syrphines was expected in the Malaise trap catch.

Sphaerophoria scripta and *Eupeodes corollae*, both of them syrphines, were the most abundant species in the sample, with 1146 and 351 specimens collected. These two species were not only abundant, but also occurred during a long period throughout the year, 5-6 months (Table 1). Sadeghi & Husseini (2009) also found in Iran that Malaise samples were clearly dominated by these two common species plus *Episyrphus balteatus*. The high ecological success of *S. scripta* and *E. corollae* is, without doubt, mediated by the high spectrum of prey of their zoophagous larvae, found in a wide range of plants, from herbs to trees (Rojo *et al*., 2003). In fact, zoophagous hoverflies dominate our Malaise trap sample from El Ventorrillo (Fig. 3).

Eristalines were more rarely collected than syrphines at El Ventorrillo, both in number of species and individuals. In addition, they had a shorter period of occurrence in the samples, of 1-2 months in most species (Table 1). This lower number of eristalines in the Malaise samples, with genera found in Sierra de Guadarrama poorly represented or even absent (see Appendix) is a consequence of the rarity and behaviour of some species. For example, *Volucella* hoverflies are frequently found flying high (Speight, 2020) and this behaviour reduces the chance for them to get captured with Malaise traps (just one specimen of *Volucella* in this Malaise catch). Saproxylic species such as those of *Spilomyia* are never abundant, their larvae live in tree rot-holes and adults visit flowers in grassy clearings (Speight, 2020). In a one-year long sampling with six Malaise traps in the woodlands of Cabañeros National Park (Ciudad Real) just two specimens of *Spilomyia* were collected (Ricarte, 2008). In general, Burgio & Sommaggio (2002, 2007) and Sommaggio & Burgio (2003) found that Malaise traps are less effective in catching saprophagous hoverflies (all saprophagous species are eristalines) than zoophagous (zoophagous species are syrphines, pipizines, microdontines, and a few *Volucella* species, which are eristalines).

Regarding the absence of Microdontinae and Pipizinae, we dismiss an overlook of these groups when sorting the Malaise catches because the person in charge was able to extract genera that can go unnoticed for someone with insufficient experience due to the small size and/or uniformly dark colouration of these flies: *Cheilosia*, *Eumerus*, *Neoascia*, *Paragus*, *Platycheirus*, and *Syritta*. That said, no *Microdon* species has ever been collected in Madrid and adjacent provinces (Ricarte & Marcos García, 2017). This lack of information on *Microdon* from this part of Spain is most likely to be an artefact of the sampling techniques and collectors. Microdontines are rarely collected and their capture frequency with Malaise traps is low (Reemer, 2012). For example, two *Microdon* species occur in the Cévennes national park, France, but they were not collected in a two-year long study with two Malaise traps within the park (Descaves, 2016). The difficulty to catch microdontines with Malaise traps is likely due to the low mobility and behaviour of *Microdon* adults: some European species disperse just a few meters from their natal ant nests and, in addition, females appear to walk more than fly (Schönrogge *et al.*, 2006; Wolton, 2011).

Pipizines is the other subfamily not represented in the Malaise catch of El Ventorrillo. Seven pipizine species are recorded from Madrid, five of them in Sierra de Guadarrama. However, records of all but one species are old (1930 or earlier) (Ricarte & Marcos-García, 2017); *Pipizella lyneborgi* Torp Pedersen, 1971, the exception, was recorded from a female collected in El Escorial in 1973 (Van Steenis & Lucas, 2011). The pipizine genus with the highest number of species recorded in Madrid is *Pipizella* Rondani, 1856 (see Appendix). The larvae of this genus are zoophagous in ant-attended aphids, but the larvae of most *Pipizella* species are unknown (Speight, 2020). Pipizines also appear to be rarely collected in Malaise traps. For example, in Cabañeros (Spain) no pipizine was collected with 10 Malaise traps in five different types of habitats during a year (Ricarte, 2008). In the Cévennes (France) just 1.4% of all collected hoverflies were pipizines (*Pipiza* + *Pipizella*) (Descaves, 2016). The absence of pipizines from the studied samples seem to be in accordance with the results of other Malaise-based surveys in Europe.

In this1989-1990 Malaise trap sample from El Ventorrillo, 41% of the species known from Sierra de Guadarrama were collected. In the Cévennes national park's sampling

effort mentioned above, one trap/year collected an average of 39% of the species recorded from this national park (Descaves, 2016), which is a very similar proportion as that between El Ventorrillo and Sierra de Guadarrama. In addition, the Malaise traps used both in the Cévennes and El Ventorrillo failed in catching microdontines and had a low success in catching pipizines (none in El Ventorrillo), as explained above. From this and other studies (e.g. Sommaggio & Burgio, 2003; Ricarte, 2008; Descaves, 2016), it is obvious that Malaise traps do not provide a full inventory of species found in an area. However, the hoverflies of a Malaise trap catch represent the community of at least the two major subfamilies (Eristalinae and Syrphinae) and provide the means to compare the largest proportion of the hoverfly diversity of a site through time, as Malaise traps, if set up at the right location, allow a systematic sampling of easy repetition with no regard to the collector skills and experience. Thus, although for a full species inventory of an area different sampling techniques should be used (Ricarte, 2008; Marcos García *et al.*, 2012), Malaise traps provide an adequate experimental design and baseline to compare tendencies in the hoverfly diversity over time. We consider that the species sample presented here could be compared with future samples obtained from El Ventorrillo with a similar sampling design.

With 126 species, Sierra de Guadarrama has 83% of the species recorded from Madrid province, and this becomes the most diverse location of Madrid and adjacent provinces for hoverflies. This high hoverfly diversity is in accordance with the high levels of biodiversity reported for other insect groups in Sierra de Guadarrama (e.g., Lobo & Martín-Piera, 2002; Nieves-Aldrey *et al*., 2003). However, the proximity of Madrid city has surely had an effect in the knowledge of biodiversity in Sierra de Guadarrama, because many collectors from the city have focused on this location for fieldwork along history; for example, collectors used to sample hoverflies in localities within Sierra de Guadarrama at least since the early twentieth century (Gil-Collado, 1930). Even nowadays, Sierra de Guadarrama is the preferred and most convenient area for city naturalists to monitor biodiversity (Fig. 6). This long history of surveys and monitoring together with the set of data provided here for El Ventorrillo makes Sierra de Guadarrama suitable for planning studies on the effects of Global change on the biodiversity of Syrphidae.

El Ventorrillo is a shelter for species of hoverflies with decreasing populations in Europe or even threatened with extinction. *Callicera macquarti* ('threatened') belongs to the saproxylic guild, with larvae developing in rot holes of mature trees (Ricarte *et al.*, 2009). Thus, forestry practices at El Ventorrillo and surroundings should allow trees to grow in size and develop holes, to promote the breeding of this rare species distributed around the Mediterranean. *Pelecocera caledonica* ('threatened') is present from Scandinavia and European Russia to Spain, where it was known only from Navarra (Speight, 2020). To propose conservation actions for *P. caledonica* would be more difficult than for *C. macquarti* since its larval biology, although suspected to be phytophagous, is completely unknown; further research on the larval biology of *P. caledonica* is required. El Ventorrillo populations of these two species and those of the 'decreasing', *C. rufa*, *C. cisalpinum*, *C. octomaculatum*, and *E. consimilis*, should be monitored to better understand the population size and trend in this part of Europe.

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Appendix

Checklist of the Syrphidae from Sierra de Guadarrama, plus all other species (*) recorded in Madrid province.
All mentioned localities belong to Sierra de Guadarrama, Madrid, except for El Espinar, La Granja/San Ildefonso, San Rafael, and Valsaín, that belong to Sierra de Guadarrama, Segovia (Fig. 1). Hoverfly species from El Ventorrillo (in bold) are new to Sierra de Guadarrama when all locality cells are blank (—). 'Sierra de Guadarrama (gen.)' is used when the published locality in a bibliographic record is just 'Sierra de Guadarrama'. Reference legend: GC1930, Gil-Collado (1930); P1962, Peris (1962); MG&L2001, Marcos-García & Louis (2001); MG*etal*2007, Marcos-García *et al*. (2007); VS&L2011, Van Steenis & Lucas (2011). GC1930 always refers to the genus *Cheilosia* with the spelling '*Chilosia*'.
For a checklist of the Syrphidae from Madrid province exclusively, the following Segovian species should be excluded from this table: *Callicera spinolae*, *Cheilosia flavipes*, *Epsitrophe nitidicollis*, *Eristalis pertinax*, *Merodon equestris*, *Volucella pellucens*, and *Xanthogramma citrofasciatum*.

	GC1930	P1962 / MG&L2001 / MGetal2007 / VS&L2011
ERISTALINAE		
*Brachypalpoides lentus**		
Brachypalpus laphriformis	—	— / — / — / —
Callicera macquarti	—	— / — / — / —
Callicera rufa	—	— / — / — / —

	GC1930	P1962 / MG&L2001 / MGetal2007 / VS&L2011
Callicera spinolae	La Granja	— / — / — / —
Ceriana vespiformis	Los Molinos, El Escorial (as *Cerioides vespiformis*)	— / — / — / —
Ceriana conopsoides	El Escorial (as *Cerioides conopoides*)	— / — / — / —
Cheilosia aerea	El Escorial (as *Chilosia zetterstedti* and *Chilosia correcta*)	— / — / — / —
*Cheilosia barbata**		
Cheilosia flavipes	San Rafael	— / — / — / —
Cheilosia gigantea	San Rafael	— / — / — / —
*Cheilosia impressa**		
Cheilosia laticornis	El Escorial, Sierra de Guadarrama (gen.) (as *Chilosia latifacies*)	— / Sierra de Guadarrama (gen.) / — / —
*Cheilosia latifrons**		
Cheilosia mutabilis	El Escorial (as *Chilosia ruralis*)	— / — / — / —
Cheilosia proxima	—	— / — / — / —
*Cheilosia soror**		
Cheilosia variabilis	El Escorial	— / — / — / —
Cheilosia vernalis	Cercedilla, Sierra de Guadarrama (gen.)	— / — / — / —
Chrysogaster basalis	Cercedilla, El Escorial	— / — / — / —
Chrysogaster coemiteriorum	Cercedilla (as *C. chalybeata* var. *coerulea*), El Escorial, Sierra de Guadarrama (as *C. chalybeata*)	— / — / — / —
*Chrysogaster virescens**		
Criorrhina asilica	El Escorial	— / — / — / —
*Criorhina ranunculi**		
Eristalinus aeneus	El Escorial, Guadarrama (as *Eristalis aeneus*)	— / — / — / —
Eristalinus sepulchralis	Guadarrama (as *Eristalis taeniops*)	— / — / — / —
Eristalinus taeniops	Sierra de Guadarrama (gen.) (as *Eristalis sepulchralis*)	— / — / — / —
Eristalis arbustorum	Sierra de Guadarrama (gen.)	— / El Escorial, Sierra de Guadarrama (gen.) / — / —
Eristalis horticola	Cercedilla, El Escorial, San Rafael	— / — / — / —
Eristalis nemorum	Sierra de Guadarrama (gen.) (as var. *sylvarum*)	— / — / — / —
Eristalis pertinax	La Granja	— / — / — / —
Eristalis similis	Cercedilla, El Escorial, Navacerrada, San Rafael, Sierra de Guadarrama (gen.) (as *E. pratorum*)	— / — / — / —
Eristalis tenax	Sierra de Guadarrama (gen.)	— / El Escorial, Sierra de Guadarrama (gen.) / — / —
*Eumerus amoenus**		
Eumerus barbarus	El Escorial	— / — / — / —
Eumerus caballeroi	El Escorial	— / — / — / —
Eumerus consimilis	—	— / — / — / —
*Eumerus grallator**		
Eumerus nudus	El Escorial	— / — / — / —
Eumerus pauper	El Espinar, El Sierra de Guadarrama (gen.)	— / — / — / —
Eumerus pulchellus	El Escorial	— / — / — / —
*Eumerus ruficornis**		
Eumerus sabulonum	El Escorial, San Rafael, Sierra de Guadarrama (gen.)	— / — / — / —
Eumerus strigatus	El Escorial, El Espinar	— / — / — / —
Eumerus sulcitibius	—	— / — / — / —

	GC1930	P1962 / MG&L2001 / MGetal2007 / VS&L2011
Eumerus tarsalis	El Escorial	— / — / — / —
Ferdinandea cuprea	El Escorial, El Paular, La Granja	— / — / — / —
Helophilus trivittatus	El Escorial, Guadarrama	— / — / — / —
Lejogaster metallina	San Rafael, Sierra de Guadarrama (gen.) (as *Chrysogaster metallina*)	— / — / — / —
Mallota dusmeti	El Escorial	— / — / — / —
*Mallota fuciformis**		
Melanogaster aerosa	Cercedilla, El Escorial (as *Chrysogaster macquarti*)	— / — / — / —
Merodon aeneus	Cercedilla, La Granja, San Rafael (as var. *crassitarsatus*)	— / Sierra de Guadarrama (gen.) / — / —
Merodon avidus	Cercedilla, El Escorial, El Paular (as *M. spinipes* var. *serrulatus*, var. *obscuritarsis* and var. *avidus*)	— / El Escorial, Sierra de Guadarrama (gen.) / — / —
Merodon chalybeus	El Escorial (as *M. spinipes* var. *obscuritarsis*)	
Merodon clavipes	El Escorial, Guadarrama, El Paular (also as *M. clavipes* var. *senilis*)	— / Sierra de Guadarrama (gen.) / — / —
Merodon escorialensis	El Escorial, Sierra de Guadarrama (gen.) (as *M. geniculatus* var. *escorialensis*)	— / — / El Escorial / —
Merodon equestris	San Ildefonso (as *M. equestris* var. *narcissi*)	— / — / — / —
*Merodon flavus**		
Merodon funestus	El Escorial	— / — / — / —
Merodon geniculatus	El Escorial, Sierra de Guadarrama (gen.)	— / — / — / —
Merodon ibericus	Cercedilla, El Escorial (as *M. spinipes* var. *bicolor*)	— / — / — / —
Merodon italicus	El Escorial (as *M. affinis*)	— / — / — / —
*Merodon nigritarsis**		
*Merodon obscuritarsis**		
Merodon parietum	—	— / Sierra de Guadarrama (gen.) / — / —
Merodon unguicornis	Sierra de Guadarrama (gen.) (also as *M. bolivari*)	— / Sierra de Guadarrama (gen.) (as *M. bolivari*) / Cercedilla / —
Merodon unicolor	Cercedilla, El Escorial, El Paular, Sierra de Guadarrama (gen.) (as *M. aeneus* var. *unicolor*)	— / — / — / —
Milesia crabroniformis	El Escorial, La Granja	— / — / — / —
Milesia semiluctifera	Cercedilla, El Escorial	— / — / — / —
Myathropa florea	El Escorial, El Paular, Guadarrama, La Granja/San Ildefonso (also as *Myiatropa florea* var. *nigrotarsata*)	— / — / — / —
*Myolepta difformis**		
Myolepta dubia	Sierra de Guadarrama (gen.) (as *Myiolepta luteola*)	— / — / — / —
*Neoascia meticulosa**		
Neoascia podagrica	—	— / — / — / —
*Neoascia tenur**		
Orthonevra frontalis	Sierra de Guadarrama (gen.) (as *Chrysogaster frontalis*)	— / — / — / —
*Orthonevra nobilis**		
*Parhelophilus versicolor**		
Pelecocera caledonica	—	— / — / — / —
Pelecocera lusitanica	El Escorial (as *Chamaesyrphus lusitanicus*)	— / — / — / —

	GC1930	P1962 / MG&L2001 / MGetal2007 / VS&L2011
*Platynochaetus setosus**		
*Rhingia rostrata**		
Riponnensia longicornis	El Escorial (as *Chrysogaster longicornis*)	— / — / — / —
Riponnensia splendens	El Escorial, Sierra de Guadarrama (gen.) (as *Chrysogaster splendens*)	— / — / — / —
Sericomyia hispanica	Cercedilla, La Granja (as *S. lappona*)	Cercedilla, La Granja / — / — / —
Sericomyia lappona	El Escorial	— / — / — / —
Spilomyia digitata	El Escorial, Guadarrama	— / Sierra de Guadarrama (gen.) / — / —
Spilomyia saltuum	El Escorial, Los Molinos	
Syritta pipiens	—	— / — / — / —
Volucella bombylans	El Escorial, Guadarrama, San Rafael (also as *V. bombylans* var. *plumata*)	— / — / — / —
Volucella elegans	Cercedilla, Collado Mediano, El Escorial, Guadarrama, La Granja, San Rafael	— / — / — / —
Volucella inanis	El Escorial, Guadarrama	— / — / — / —
Volucella pellucens	La Granja	— / — / — / —
Volucella zonaria	Sierra de Guadarrama (gen.)	— / — / — / —
Xylota segnis	El Escorial, La Granja	— / — / — / —
Xylota sylvarum	Cercedilla, El Paular, La Granja, Valsaín	— / — / — / —
PIPIZINAE		
Claussenia hispanica	El Escorial (as *Pipizella heringii* var. *hispanica*)	— / — / — / —
*Pipiza festiva**		
Pipizella annulata	El Escorial (as *P. virens* var. *annulata*)	— / — / — / —
Pipizella lyneborgi	—	— / — / — / El Escorial
Pipizella maculipennis	Sierra de Guadarrama (gen.)	— / — / — / —
*Pipizella viduata**		
Pipizella virens	Cercedilla, El Escorial, Guadarrama, Sierra de Guadarrama (gen.)	— / — / — / —
SYRPHINAE		
Chrysotoxum bicinctum	Cercedilla	— / — / — / —
Chrysotoxum cisalpinum	—	— / — / — / —
Chrysotoxum festivum	Cercedilla, Lozoya, Sierra de Guadarrama (gen.)	— / El Escorial, Sierra de Guadarrama (gen.) (as *C. arcuatum*) / — / —
Chrysotoxum gracile	Lozoya (as *C. festivum* var. *gracile*)	— / — / — / —
Chrysotoxum intermedium	Cercedilla, El Escorial, La Granja	— / — / — / —
Chrysotoxum latifasciatum	Cercedilla, El Escorial, El Paular, La Granja, Sierra de Guadarrama (gen.), Valsaín	— / Sierra de Guadarrama (gen.) / — / —
Chrysotoxum octomaculatum	—	— / El Escorial (as *C. latifasciatum*) / — / —
Chrysotoxum* sp. *near vernale	—	— / — / — / —
Chrysotoxum vernale	El Escorial	— / — / — / —
Chrysotoxum volaticum	El Escorial, San Ildefonso	— / — / — / —
Dasysyrphus albostriatus	—	— / — / — / —
Dasysyrphus pauxillus	—	— / — / — / —
Dasysyrphus tricinctus	—	— / — / — / —
Didea intermedia	—	— / — / — / —
Doros profuges	Cercedilla (as *Doros conopeus*)	— / — / — / —
*Epistrophe eligans**		
Epistrophe nitidicollis	La Granja	— / — / — / —

	GC1930	P1962 / MG&L2001 / MGetal2007 / VS&L2011
Episyrphus balteatus	Sierra de Guadarrama (gen.)	— / — / — / —
Eupeodes corollae	El Escorial, San Rafael (as *Syrphus luniger*)	— / — / — / —
Eupeodes latifasciatus	—	— / — / — / —
*Eupeodes lucasi**		
Eupeodes luniger	Cercedilla, El Escorial (as *Syrphus corollae* var. *fulvifrons* and var. *nigrofemoratus*)	— / — / — / —
Melangyna triangulifera	El Escorial (as *Syrphus triangulifer*)	— / — / — / —
Melanostoma mellinum	Cercedilla, El Escorial, El Paular	— / — / — / —
Melanostoma scalare	Cercedilla, El Escorial	— / — / — / —
Meliscaeva auricollis	Cercedilla	— / — / — / —
Paragus albifrons	Cercedilla	— / — / — / —
Paragus bicolor	Cercedilla, Collado Mediano, El Escorial, El Espinar, San Rafael, Sierra de Guadarrama (gen.) (also as *P. bicolor* var. *testaceus* and *taeniatus*)	— / — / — / —
*Paragus finitimus**		
Paragus haemorrhous	El Escorial, Sierra de Guadarrama (gen.) (as *P. tibialis* var. *haemorrhous*)	— / — / — / —
Paragus pecchiolii	—	— / — / — / —
Paragus quadrifasciatus	Sierra de Guadarrama (gen.)	— / — / — / —
Paragus strigatus	Cercedilla, El Espinar	— / — / — / —
Paragus tibialis	Sierra de Guadarrama (gen.) (as *P. tibialis* var. *obscurus* and var. *trianguliferus*)	— / — / — / —
*Paragus vandergooti**		
Parasyrphus punctulatus	—	— / — / — / —
Platycheirus albimanus	Cercedilla, El Escorial	— / — / — / —
Platycheirus scutatus	—	— / — / — / —
Scaeva albomaculata	Cercedilla, El Escorial, El Paular (as *Lasyophticus albomaculatus*)	— / — / — / —
Scaeva mecogramma	Cercedilla (as *Syrphus posticatus*)	— / — / — / —
Scaeva pyrastri	El Escorial, El Paular, La Granja, Sierra de Guadarrama (gen.), Valle del Paular (as *Lasyophticus pyrastri*)	— / — / — / —
Scaeva selenitica	Cercedilla, El Escorial, El Paular, San Ildefonso (as *Lasyophticus seleniticus*)	— / — / — / —
*Sphaerophoria interrupta**		
*Sphaerophoria rueppellii**		
Sphaerophoria scripta	Sierra de Guadarrama (gen.)	— / — / — / —
Syrphus ribesii	Cercedilla, El Escorial, La Granja	— / — / — / —
Syrphus torvus	—	— / — / — / —
Syrphus vitripennis	San Rafael (as *S. ribesii* var. *vitripennis*)	— / Sierra de Guadarrama (gen.) / — / —
Xanthandrus comtus	—	— / — / — / —
Xanthogramma citrofasciatum	San Rafael	— / — / — / —
*Xanthogramma marginale**		
Xanthogramma dives	—	— / — / — / —
Xanthogramma pedissequum	El Escorial (as *X. ornatum*)	— / — / — / —